Electronics and
Computer Science

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Trailblazers

The History of Hypertext

- Dr Nicholas Gibbins - nmg@ecs.soton.ac.uk
- 2013-2014

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Hypertext Prehistory

- St Cuthbert Gospel, C7th England

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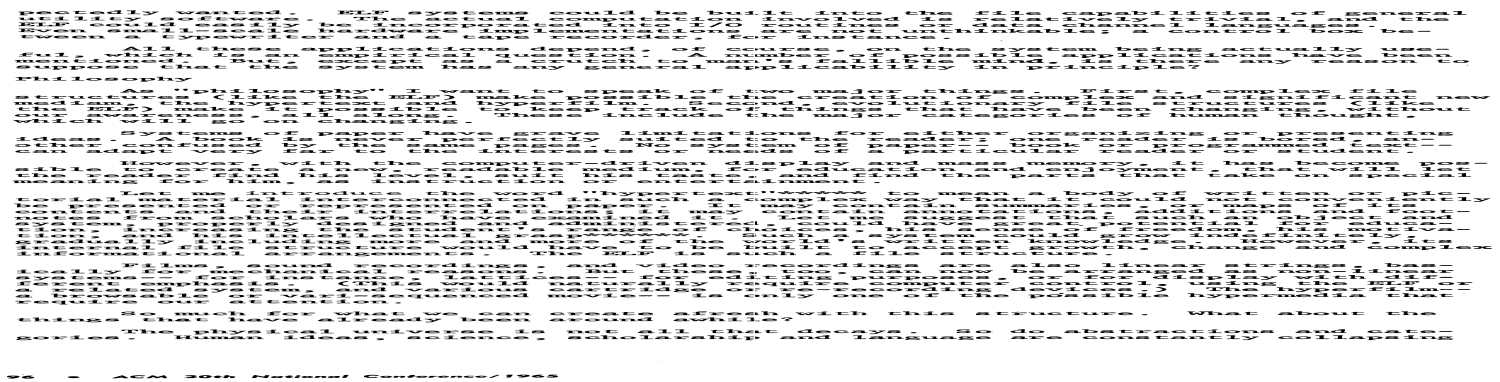
Revisiting Nelson's Definition



Nelson, T.H. (1965) *A file structure for the complex, the changing and the indeterminate*. Proceedings of the 20th ACM National Conference..

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The Talmud

Central text of Rabbinical Judaism

- Encoding of oral tradition
- Commentaries on original text
- Commentaries on commentaries

Richard White of Basingstoke

Author of *Historiarum libri cum notis antiquitatum Britannicarum (1597-1607)*

"as bees take honey from different flowers, so we must take materials from all sorts of different authors and, once they have been systematically collected, store them away, as it were, in the proper combs."

One of the earliest scholars to

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Hypertext Pioneers

- http://www.flickr.com/photos/intherough/3470183543/

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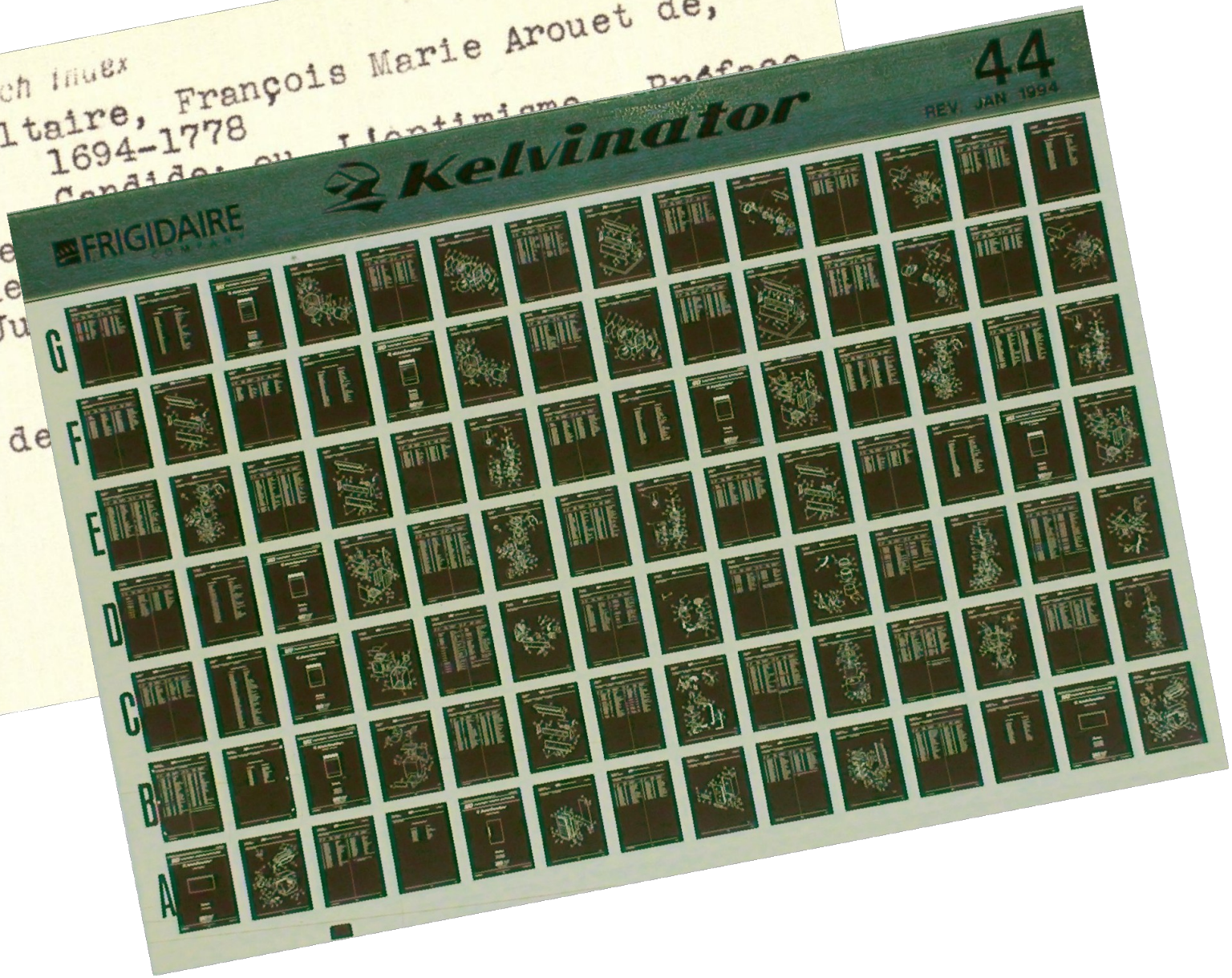
Paul Otlet

Belgian lawyer, internationalist and 'father of Information Science'

- Created the Universal Decimal Classification for libraries (still in use around the world)

With Henri La Fontaine, established the Répertoire Bibliographique Universel in



The Mundaneum

A central repository for all the world's knowledge!

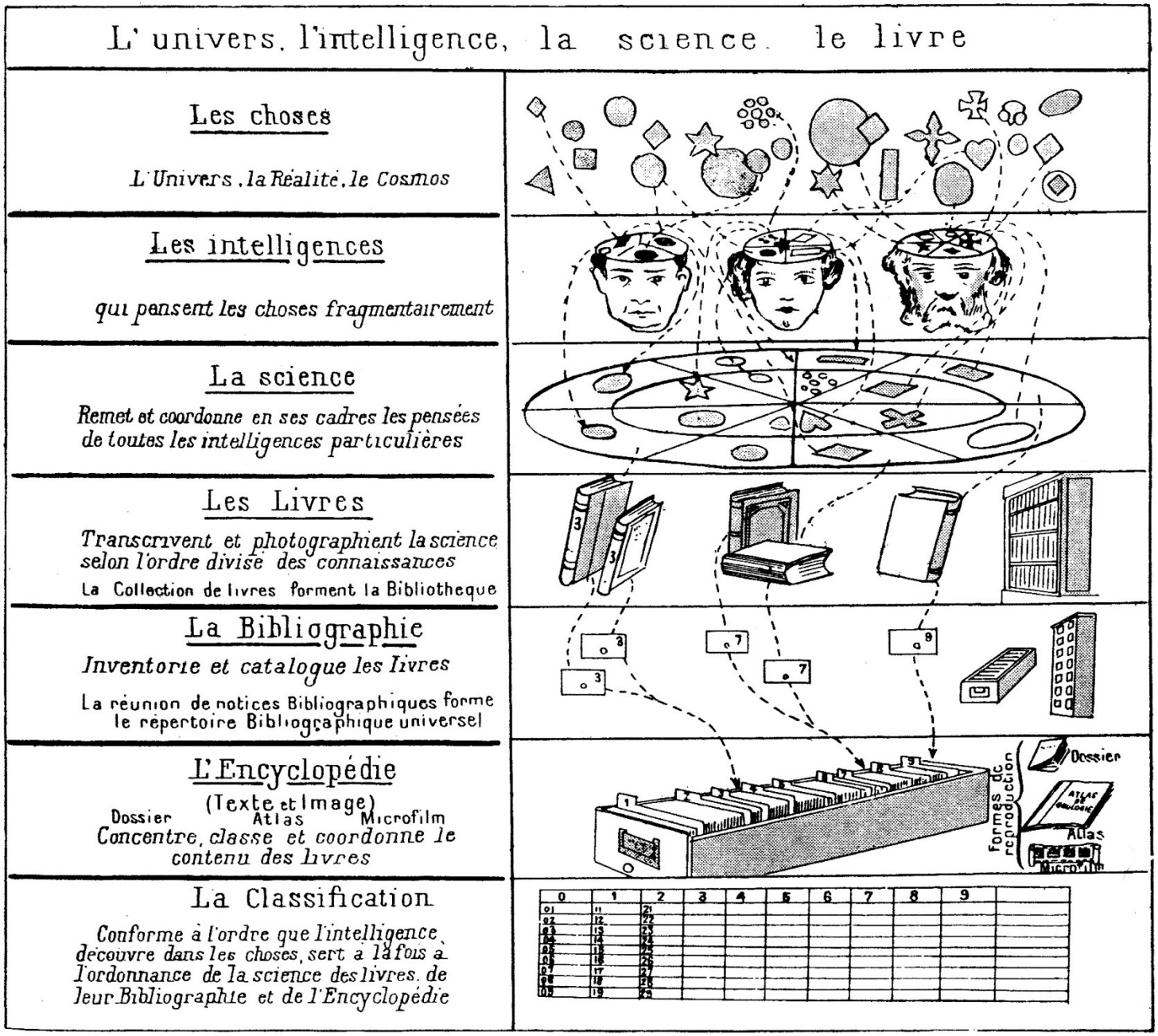
- Founded in 1910 by Otlet and La Fontaine
- Built on the earlier Repertoire Bibliographique Universel
- Planned at the centerpiece of a 'world city', designed by Le Corbusier in 1929 and to be built outside Geneva

Drag picture to placeholder or click icon to add

The Mundaneum

- After Swiss plans fell through, project relocated to Brussels
- Closed in 1934, damaged in 1940 under Nazi occupation

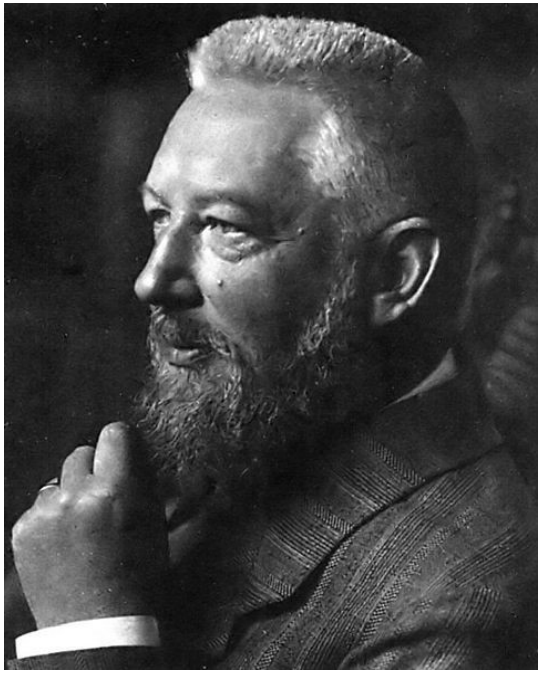
Rayward, W.B. (1994) *Visions of Xanadu: Paul Otlet (1868-1944) and Hypertext*. Journal of the American Society of Information Science, 45(4), pp. 235-250.



Otlet, P. (1934) *Traité de Documentation*. Brussels: Editiones Mundaneum, p.41.

Wilhelm Ostwald

German chemist and Nobel Prize winner



- Inspired by Otlet, established Die Brücke (The Bridge) using his prize money
- International Institute for the Organizing of Knowledge Work
- Reduce literature to small units of recorded knowledge ('monos') that could be

Hapke, T. (1998) *Wilhelm Ostwald, the "Bru□cke" (Bridge), and Connections to Other Bibliographic Activities at the Beginning of the Twentieth Century*. Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems. pp.139-147.

Die Brücke

Die Bru□cke is planned as a central station, where any question which may be raised with respect to any field of intellectual work whatever finds either direct answer or else indirect, in the sense that the inquirer is advised as to the place where he can obtain sufficient information

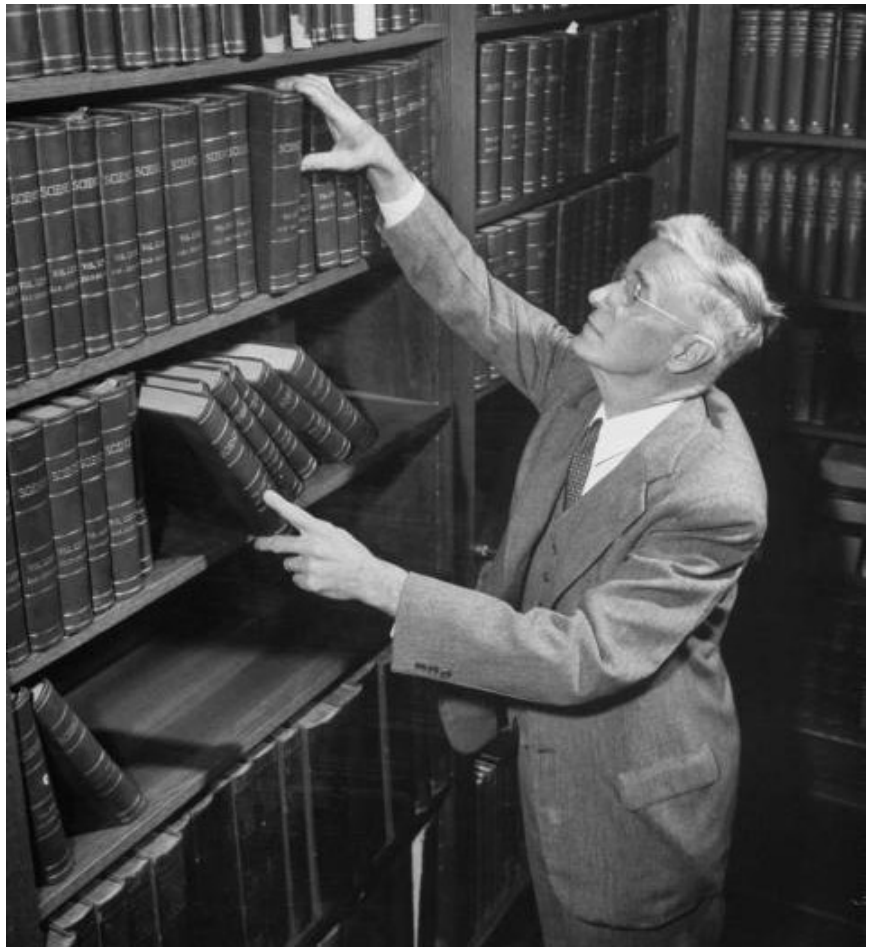
Ostwald, W. (1913) *Scientific Management for Scientists*. Scientific American, 108(1), pp. 5-6.

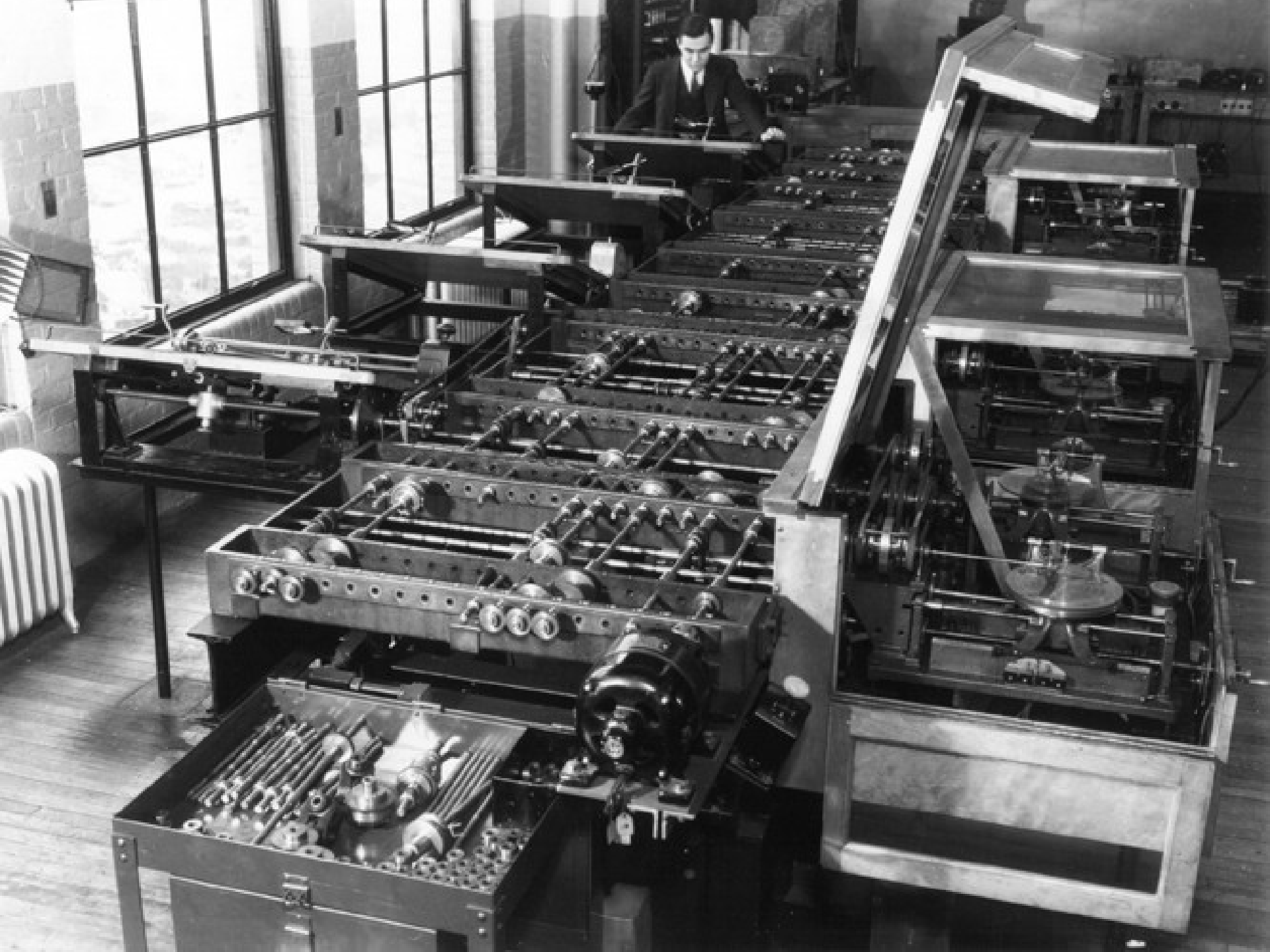
Vannevar Bush

Prewar work on analogue computing – the Differential Analyser

Director of the US Office of Scientific Research and Development during WWII

De facto director of the Manhattan Project until 1943





Drag picture to placeholder or click icon to add

- Wikimedia Commons

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The Rapid Selector

Buckland, M.K. (1992) *Emanuel Goldberg, electronic document retrieval, and Vannevar Bush's Memex*. Journal of the American Society of Information Science, 43(4), pp. 284-294.

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As We May Think

"The difficulty seems to be, not so much that we publish unduly in view of the extent and variety of present-day interests, but rather that publication has been extended far beyond our present ability to make real use of the record."

Bush, V. (1945) *As We May Think*. The Atlantic Monthly, 176, pp.101-108.

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As We May Think

"Our ineptitude in getting at the record is largely caused by the artificiality of systems of indexing. [...] Having found one item, moreover, one has to emerge from the system and re-enter on a new path."

"The human mind does not work that way. It operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts."

"...the speed of action, the intricacy of trails, the detail of mental pictures, is awe-inspiring beyond all else in nature."

The Memex

An electro-mechanical analogue device for organising knowledge: microfilm, photocells and typewriter.

Allows user to create:

- Associative trails – arbitrary sequences of pages
- Skip trails – relevant

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A Salient Prediction

"Wholly new forms of encyclopedias will appear, ready made with a mesh of associative trails running through them, ready to be dropped into the memex and there amplified."

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Doug Englebart

Member of the Stanford Research Institute and founder of the Augmentation Research Center

ARC played key role in early Internet history

Nov. 17, 1970 D. C. ENGELBART 3,541,541

X-Y POSITION INDICATOR FOR A DISPLAY SYSTEM

Filed June 21, 1967 3 Sheets-Sheet 1

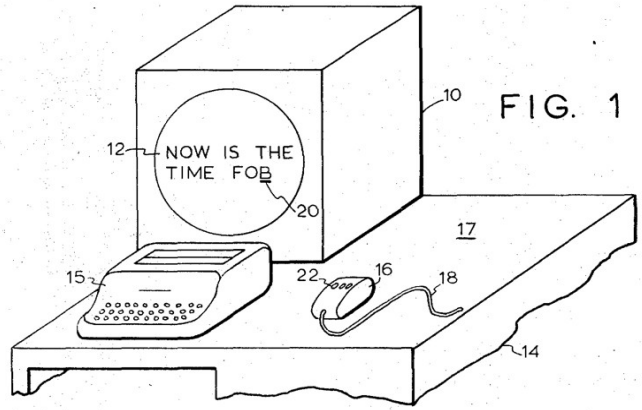

FIG. 1

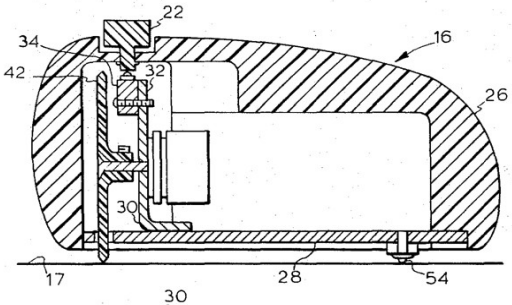

FIG. 2

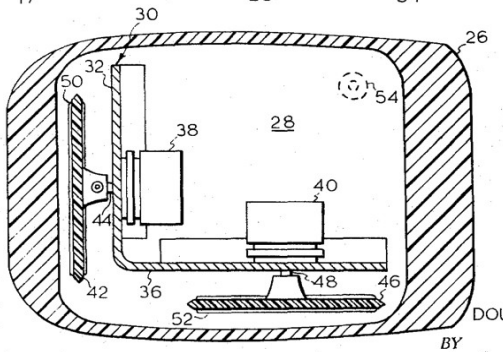

FIG. 3

INVENTOR.
DOUGLAS C. ENGELBART
BY
Lindenberg + Freilich
ATTORNEYS

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Augmenting Human Intellect

a new stage of human evolution, characterized by "automated external symbol manipulation”

“we are concentrating fully upon reaching the point where we can do all of our work on line — placing in computer store all of our specifications, plans, designs, programs, documentation, reports, memos, bibliography and reference notes, etc., and doing all of our scratch work, planning, designing, debugging, etc., and a good deal of our intercommunication, via the consoles”.

Engelbart, D.C. and English, W.K. (1968) *A research center for augmenting human intellect*. Proceedings of the 1968 Fall Joint Computer Conference, San Francisco, CA. pp. 395-410

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NLS – the oN-Line System

Timesharing computer with multiple consoles

UI features:

- Windowed display
- Mouse
- Chorded keyboard
- Videoconferencing
- Links in content

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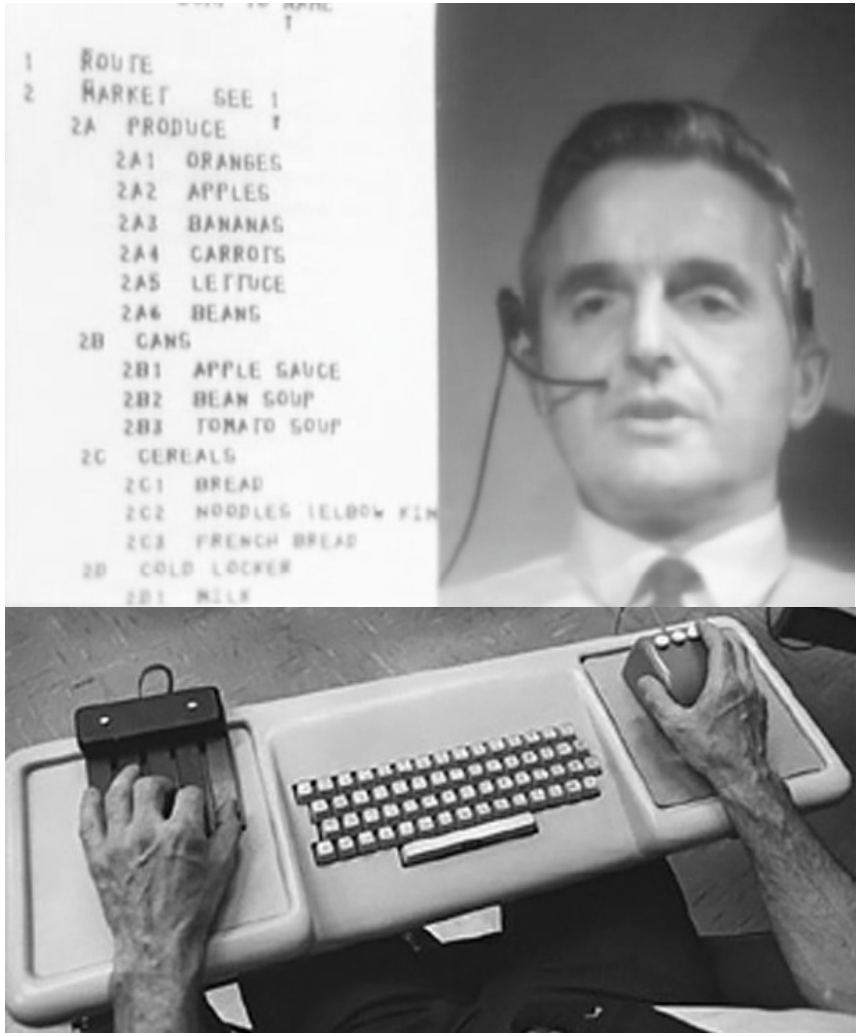
The Mother of all Demos



http://sloan.stanford.edu/MouseSite/1968Demo.html

Ted Nelson

Sociologist, philosopher and film maker

- Coined the term “hypertext”

“A user interface should be so simple that a beginner in an emergency can understand it within ten seconds.”

“Most people are fools, most authority is

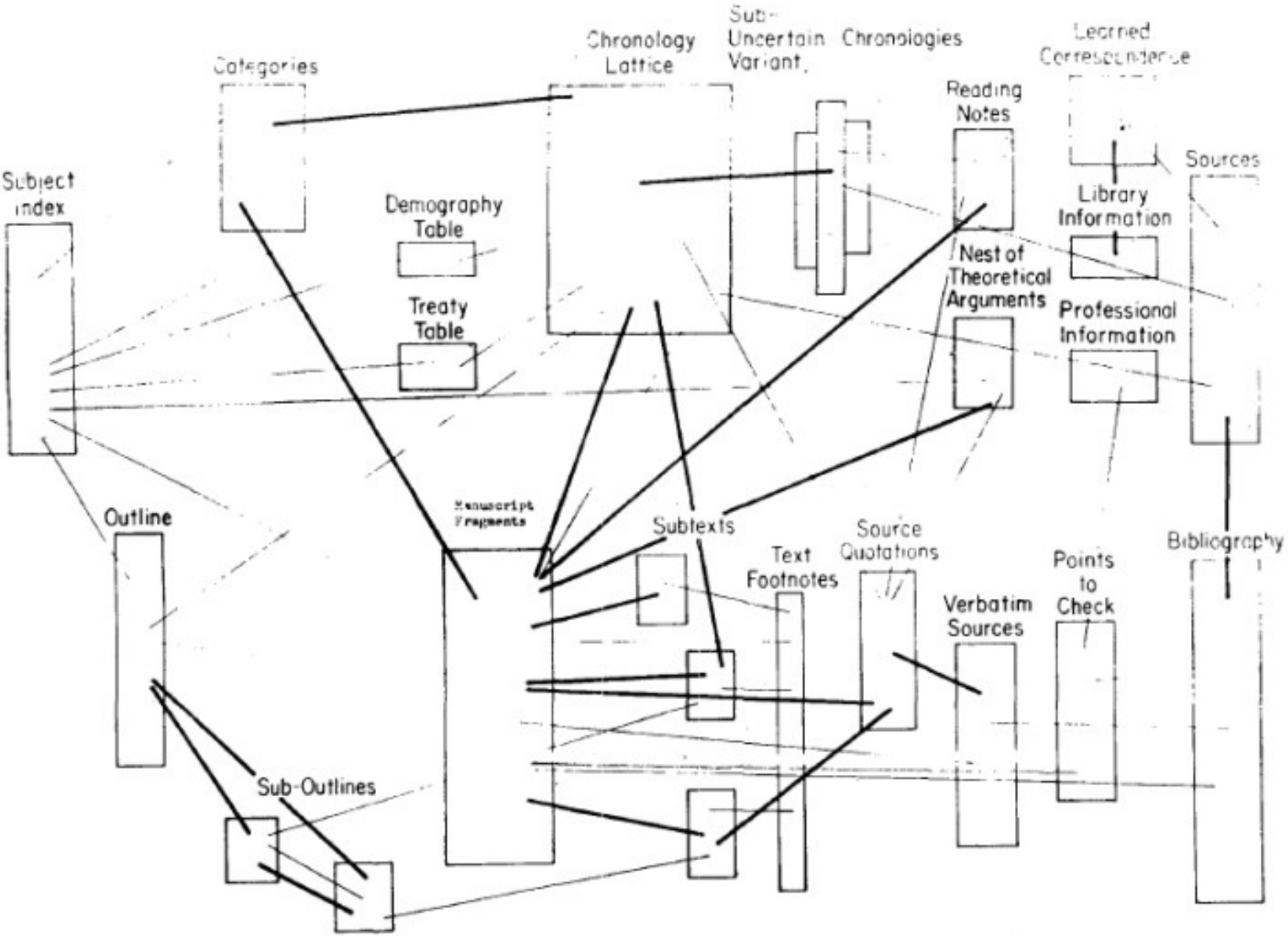


***FIGURE 4*—ELF's capacity for total filing: hypothetical use by historian. Thin lines indicate links; heavy rules indicate some of same entries.**

Computer Lib/Dream Machines

"No one's life has yet been simplified by a computer."

Two books in a dos-a-dos binding:

- Computer Lib is a clarion call for people to understand computers deeply
- Dream Machines is a sketch of the flexible media

Nelson, T.H. (1974) *Computer Lib/Dream Machines*. Chicago, IL: Nelson, T.H.

A Vision in a Dream

In 1797, Samuel Taylor Coleridge wrote the poem *Kubla Khan* after awaking from an opium dream:

In Xanadu did Kubla Khan
A stately pleasure-dome decree:
Where Alph, the sacred river, ran
Through caverns measureless to man
Down to a sunless sea.

He was interrupted by a

Project Xanadu

Founded in 1960, still ongoing (famously never finished)

Hugely influential, nonetheless

Described in *Dream Machines*, and Nelson's subsequent book *Literary Machines*

Nelson, T.H. (1993) *Literary Machines*. Sausalito, CA: Mindful Press.

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Project Xanadu Mission Statement

DEEP INTERCONNECTION WITH INTERCOMPARISON AND RE-USE

Since 1960, we have fought for a world of deep electronic documents--with side-by-side intercomparison and frictionless re-use of copyrighted material.

We have an exact and simple structure. Our model handles automatic version management and rights management through deep connection.

Today's popular software simulates paper. The World Wide Web (another imitation of paper) trivializes our original hypertext model with one-way ever-breaking links and no management of version or contents.

WE FIGHT ON.

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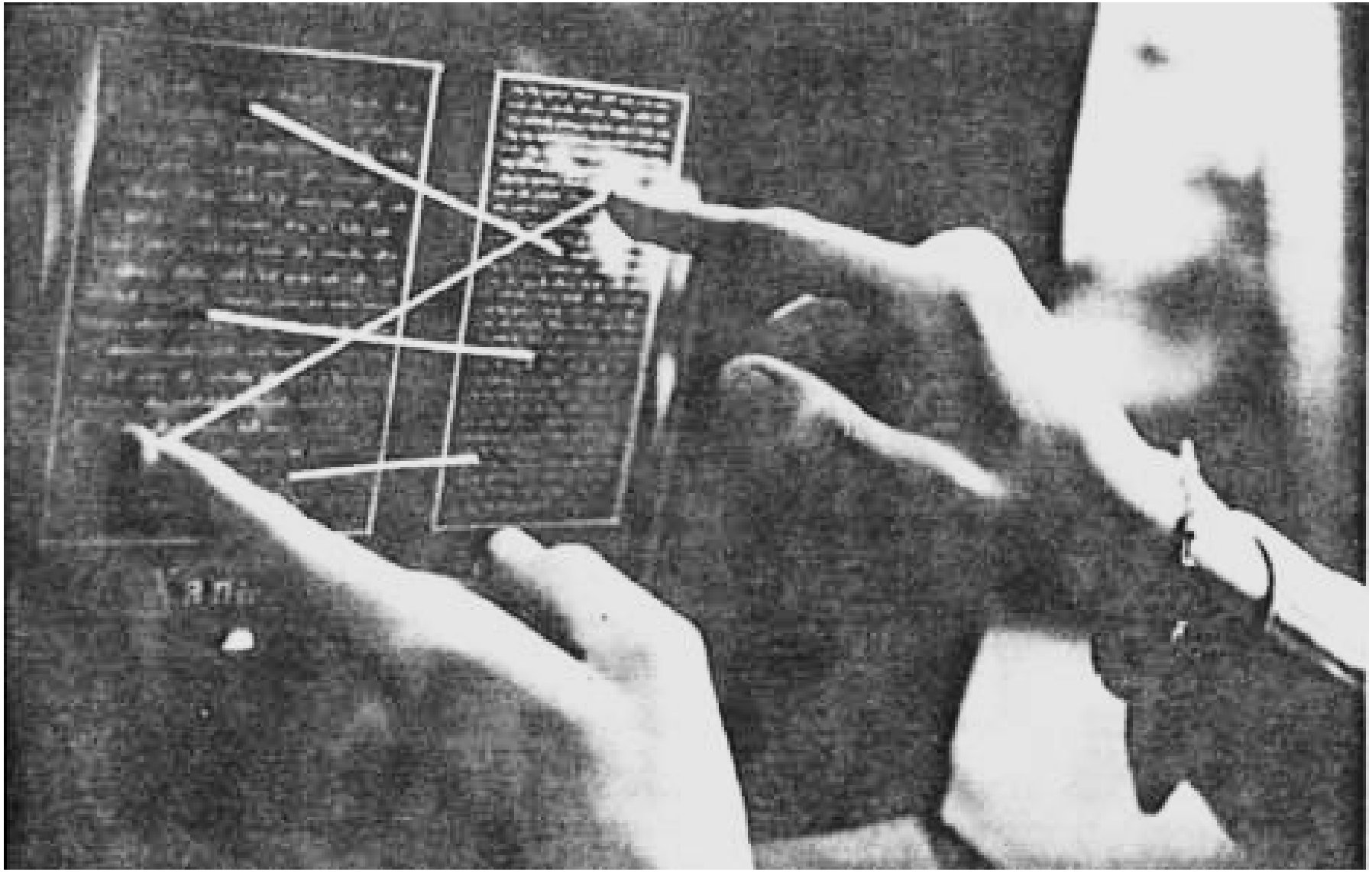
Project Xanadu

- Intercomparison of parallel documents
- World-wide publishing without barriers
- Links that don't break
- Versioning
- Transclusion
- Transcopyright



Nelson, T.H. (1972) *As We Will Think*. Proceedings of Online 72 Conference, Uxbridge, England.

1. Every Xanadu server is uniquely and securely identified.

2. Every Xanadu server can be operated independently or in a network.

3. Every user is uniquely and securely identified.

4. Every user can search, retrieve, create and store documents.

5. Every document can consist of any number of parts each of which may be of any data type.

6. Every document can contain links of any type including virtual copies ("transclusions") to any other document in the system accessible to its owner.

7. Links are visible and can be followed from all endpoints.

8. Permission to link to a document is explicitly granted by the act of publication.

9. Every document can contain a royalty mechanism at any desired degree of granularity to ensure payment on any portion accessed, including virtual copies of all or part of the document.

10. Every document is uniquely and securely identified.

11. Every document can have secure access controls.

12. Every document can be rapidly searched, stored and retrieved without user knowledge of where it is physically stored.

13. Every document is automatically moved to physical storage appropriate to its frequency of access from any given location.

14. Every document is automatically stored redundantly to maintain availability even in case of a disaster.

15. Every Xanadu service provider can charge their users at any rate they choose for the storage, retrieval and publishing of documents.

16. Every transaction is secure and auditable only by the parties to that transaction.

17. The Xanadu client-server communication protocol is an openly published standard. Third-party software development and integration is encouraged.

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XanaduSpace

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Nelson on the Web

The Xanadu project did not ‘fail to invent HTML’. HTML is precisely what we were trying to PREVENT - ever-breaking links, links going outward only, quotes you can't follow to their origins, no version management, no rights management.

Drag picture to placeholder or click icon to add

Hypertext Systems

- http://www.flickr.com/photos/mwichary/2355783479/

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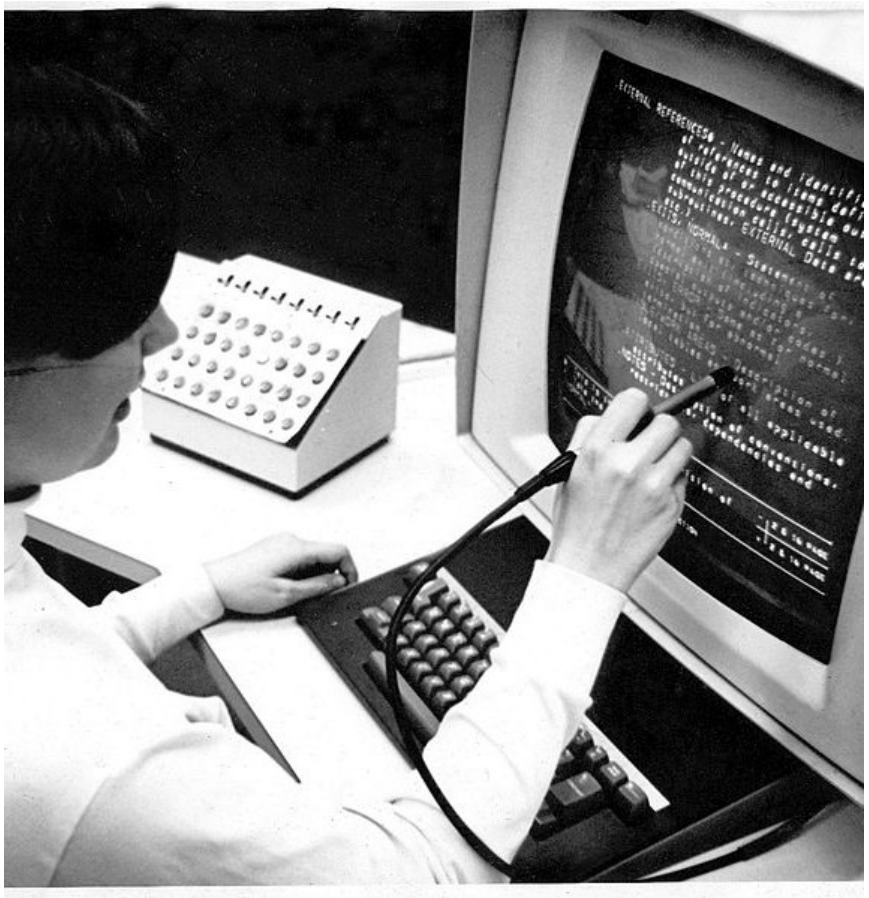
HES/FRESS (1967)

Hypertext Editing System developed at Brown University

Used by NASA to produce and manage documentation for the Apollo programme



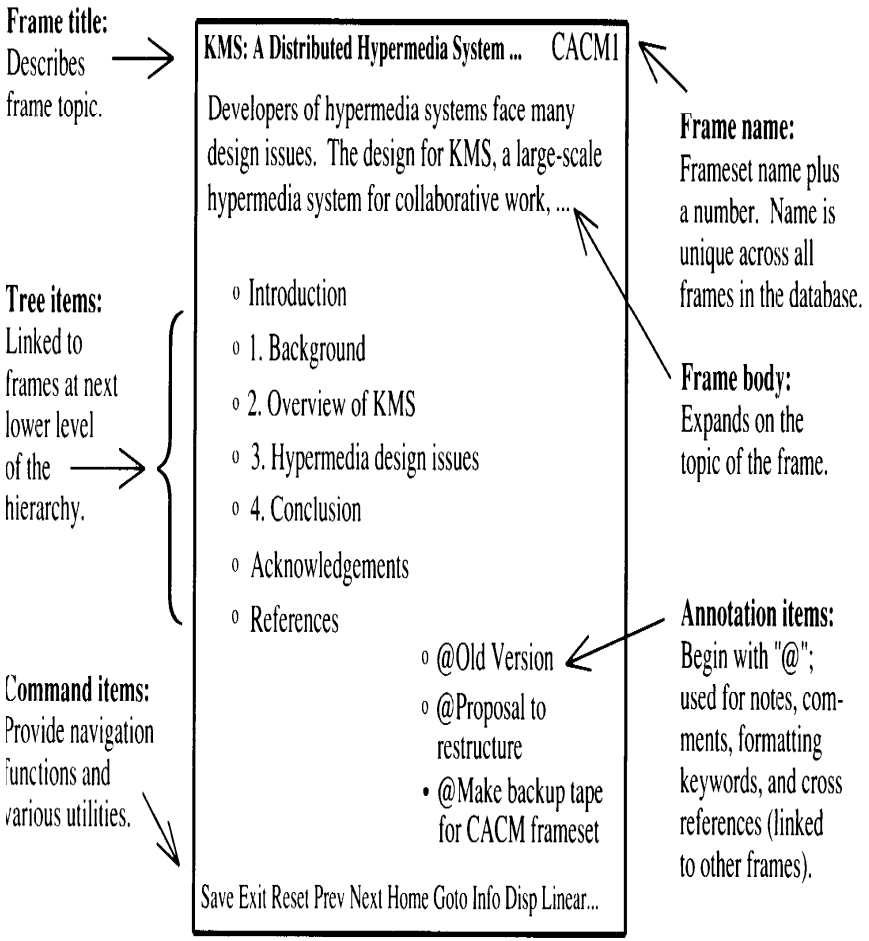
Carmody, S. et al (1969) *A Hypertext Editing System for the /360*. Pertinent Concepts in Computer Graphics: Proceedings of the Second University of Illinois Conference on Computer Graphics, pp.291-330.

ZOG (1975)

Developed at Carnegie Mellon University

Features:

- Early proponent of the "card" or "frame" model of hypertext (c.f. index cards)
- One-way links, embedded in frames



Robertson, G. et al (1981) *The ZOG approach to man-machine communication*. Int. J. Man-Machine Studies, 14, pp. 461-488.

Commercialised as KMS

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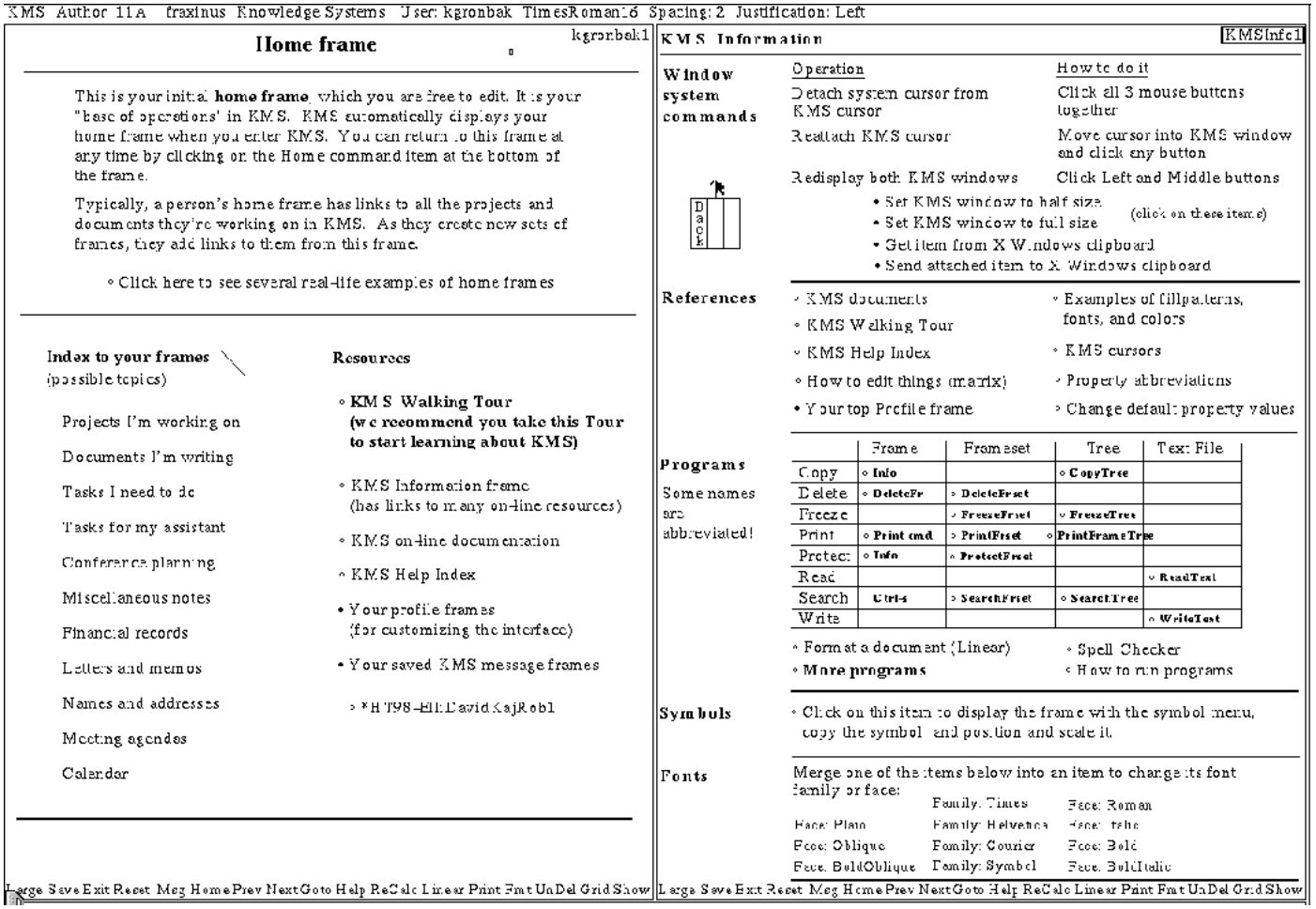
Knowledge Management System (1983)



Akscyn, R.M. et al (1988) *KMS: A distributed hypermedia system for managing knowledge in organizations*. Communications of the ACM, 31(7), pp. 820-835.

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Hyperties (1983)

Developed by Ben Schneiderman at the University of Maryland

Features:

- Link previews
- Links point to whole documents

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Intermedia (1985)

Developed at Brown University

Features:

- A/UX-based
- Bidirectional linking
- Graphics

Garrett, L.N. et al (1986) *Intermedia: issues, strategies, and tactics in the design of a hypermedia document system*. Proceedings of the 1986 ACM conference on Computer-supported cooperative work, pp.163-174.

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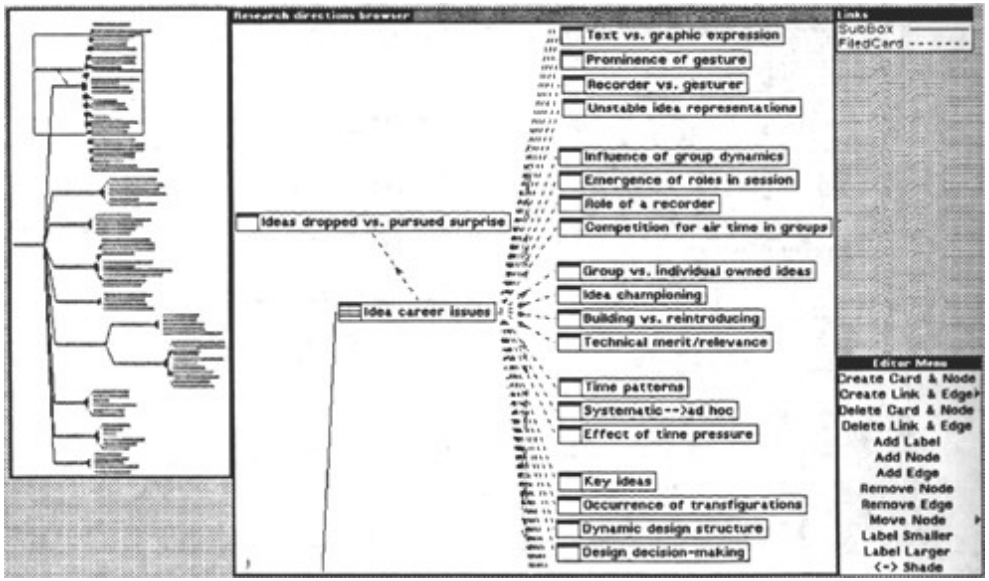
NoteCards (1985)

Developed at Xerox PARC
(Trigg, Moran and Halasz)



Features:

- Hierarchical browser
- Programmable API
- Graphics

Halasz, F.G. et al (1986) *NoteCards in a Nutshell*. SIGCHI Bulletin, 18(4), pp.45-52.

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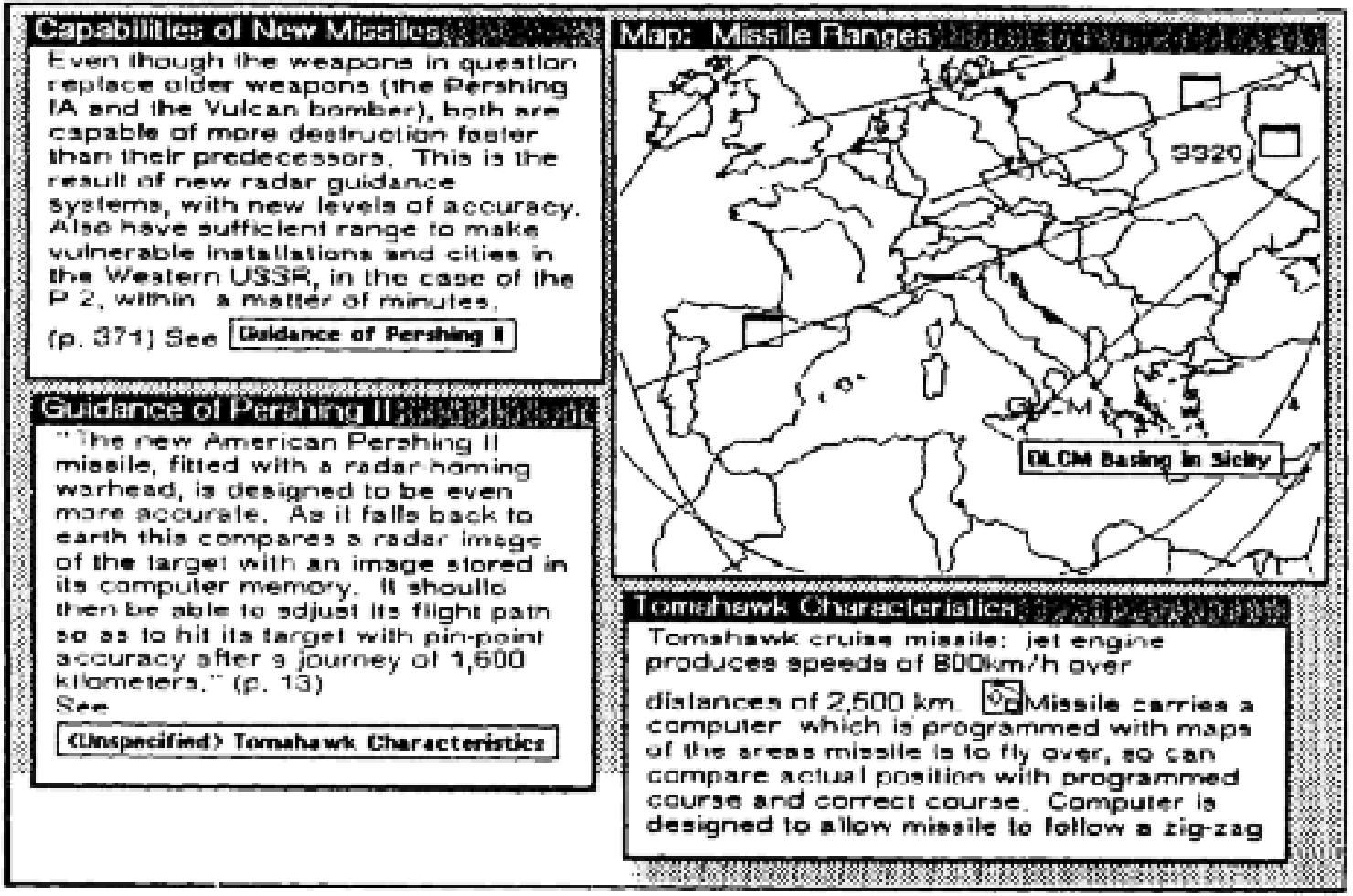
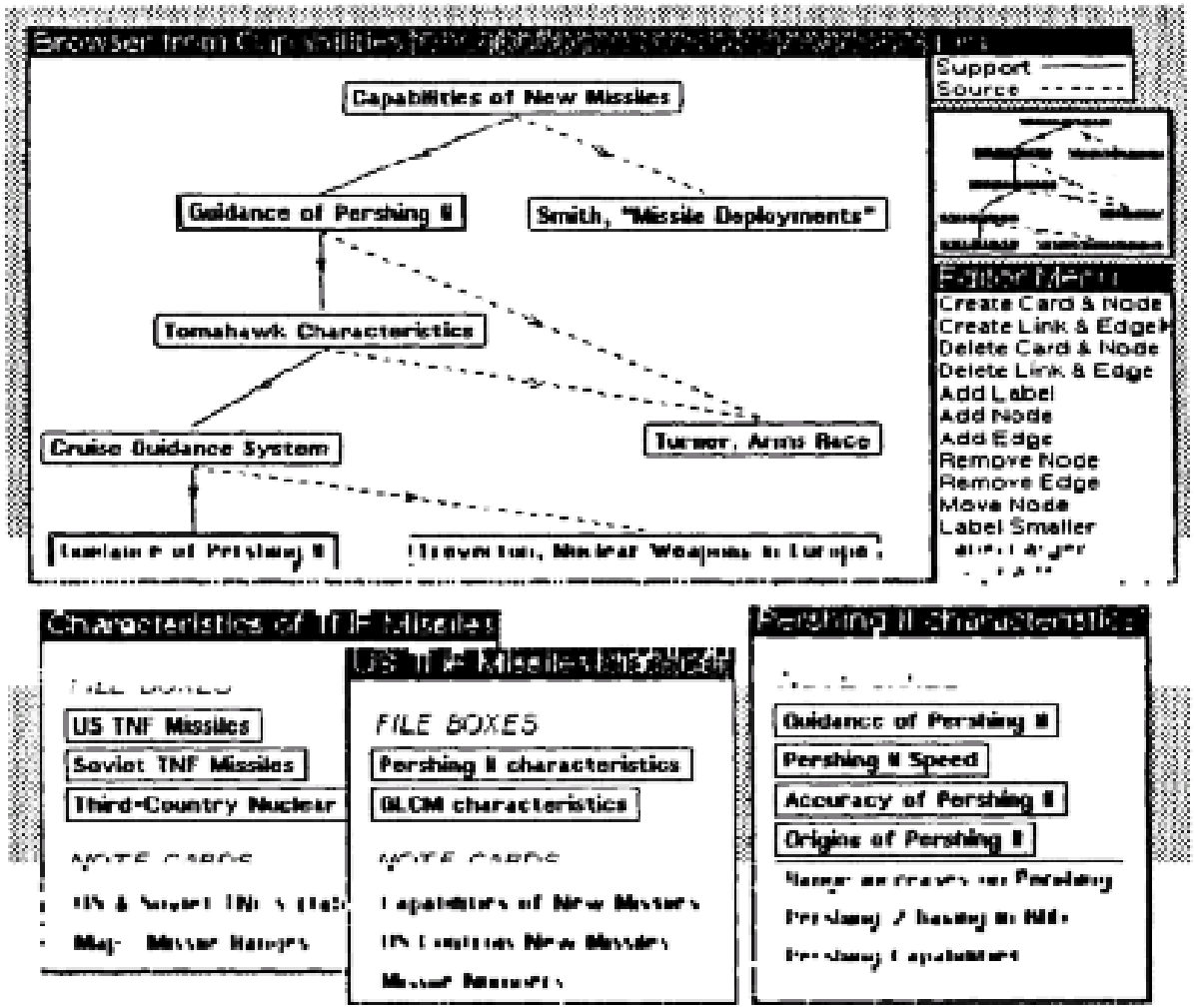
NoteCards: Showing card with iconic anchors



NoteCards: Showing browser



Hypercard (1987)

Developed by Apple Computer Inc., and bundled with new Mac SEs.

Features:

- OO programming language (Hypertalk)
- Graphics
- Widely used for application development

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Conklin on Hypertext

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Hypertext: An Introduction and Survey

"The concept of hypertext is quite simple: windows on the screen are associated with objects in a data base and links are provided between these objects, both graphically (i.e. as labelled icons) and in the data base (i.e. as pointers)."

Conklin, J. (1987) *Hypertext: An introduction and survey*. IEEE Computer, 20(9), pp.17-41.

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Macro Literary Systems

Large on-line libraries in which inter-document links are machine supported; all publishing, reading, collaboration, and criticism takes place within the network

e.g. Memex, NLS/Augment, Nelson's Xanadu

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Problem Exploration Tools

Tools to support early unstructured thinking on a problem when many disconnected ideas come to mind

- Early authoring and outlining
- Problem solving
- Programming and design

e.g. IBIS

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Structured browsing Systems

Smaller-scale systems for teaching, reference, and public information, where speed of access and ease of use is crucial

- Typically designed only for reading, not for authoring

e.g. ZOG/KMS, Hyperties

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General Hypertext Technology

Research platforms to allow experimentation with a range of hypertext applications; most commonly applied to reading, writing, collaboration

e.g. NoteCards, Intermedia, HES/FRESS

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The Essence of Hypertext

- Nodes
  - The power to chunk information
- Links
  - Importance of speed of link resolution
  - Direction/arity?
  - Names?
  - Properties?
  - End as region or node?
  - Reference by name or by value
  - Display characteristics?

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The Essence of Hypertext

- Trees (strict hierarchies) or networks of links
- Clusters of Links (webs/linkbases?)
- Clusters of Nodes (Composites)
- History
- Trails
- Authoring and Annotating!
- Browsers (meaning node level)

Disadvantages of Hypertext

- Disorientation: the tendency to lose one's sense of location and direction in a non-linear document; “Lost in Hyperspace”

- Cognitive overhead: the additional effort and concentration necessary to maintain several tasks or trails at one time.

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Halasz on Hypertext

Reflections on Notecards

In 1989, Halasz identified seven issues for the next generation of hypertext systems:

1. Search and query
2. Composites
3. Virtual Structures
4. Computation over networks
5. Versioning
6. Support for collaboration
7. Extensibility

Halasz, F. (1989) *Reflections on Notecards: seven issues for the next geeneration of hypermedia systems*, Communications of the ACM, 31(7), pp. 836-852.

The seven issues

Issue 1: Search and query in a hypermedia network

- Link Navigation is not always the best way to find things
- Better might be Content Based or Structural Search

Issue 2: Composites - augmenting the basic model

- A way of representing and dealing with sets (or sub-networks) of nodes and links as unique entities separate from their components

Issue 3: Virtual structures

- Virtual Structures would be created by a query and would be equivalent to virtual tables in a relational database

The seven issues

Issue 4: Computation in (over) hypermedia networks

- The idea is to provide APIs to allow cards to be orchestrated and scripts to be executed when certain events occur

Issue 5: Versioning

- Halasz argued that versioning was a natural feature of OSs that got lost with DOS. Versioning of HTs is difficult.

Issue 6: Support for collaborative work

Issue 7: Extensibility and tailorability

- The ability to change the system to extend and change behaviours, have different appearances and use different hypertext models

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Halasz on Hypertext (part 2)

Seven Issues Revisited

Halasz gave a keynote at Hypertext ‘91 in San Antonio that reconsidered and amended his seven issues:

1. Ending the tyranny of the link
2. Open Systems
3. User interfaces for large information spaces
4. Very large hypertexts

http://www2.parc.com/spl/projects/halasz-keynote/

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Ending the Tyranny of the Link

Hypermedia that includes non-network structures as well as virtual structures on an equal footing with network structures.

- Wider variety of hypermedia “data models”
- Provides increased opportunity for integration with a variety of complementary systems and technologies

Open Systems

"The monolithic hypermedia system of the 1980s is no longer a viable species (!)"

Introduction of *open hypermedia systems*:

- Decompose HT system into separate components
- Define communications protocols and formats for coordination

User Interfaces for Large Information Spaces

Interfaces that allow users to manipulate large network structures on a workstation screen is a long-standing problem for many hypermedia systems

- Many previous systems used some form of network browser, but not always successfully

Very Large Hypertexts

Very large: >10's or 100's of thousands of documents (!)

- Large hypertexts uncommon at this time
- One of the main selling points in the hypertext vision has been its proficiency in helping to manage VERY LARGE document collections
- Challenge is to build a useable industrial-strength hypertext system capable of handling 10,000 documents (!)

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...and then the Web happened

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1990

Three new Hypertext systems made their first appearance

- The World Wide Web
- Hyper-G
- Microcosm

The above list is roughly in ascending order of their compliance with Halasz's seven issues…

…and in descending order of their uptake

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Web Growth

Nielsen, J. (2006) *100 Million Websites*, Alertbox.
http://www.useit.com/alertbox/web-growth.html

What is (was) the Web?

The idea of a boundless information world in which all items have a reference by which they can be retrieved - address system (URIs)

A network protocol to fetch addressed items - (HTTP)

A mark-up language (HTML) which every client must understand how to render - and which can contain hotlinks to given addresses